MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

PPH0255– PHYSICS

(Foundation in Information Technology)

10 MARCH 2016
2.30 P.M – 4.30 P.M
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 7 printed pages with **TWO SECTIONS**, excluding the cover page, physical constants and formula list.

2. Attempt **ALL** questions in **Section A** and **ONE** question in **Section B**. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

LIST OF PHYSICAL CONSTANTS

Acceleration due to gravity	g	$9.80\ \text{m/s}^2$
Electron mass	m_e	$9.11 \times 10^{-31}\ \text{kg}$
Proton mass	m_p	$1.67 \times 10^{-27}\ \text{kg}$
Elementary Charge	e	$1.602 \times 10^{-19}\ \text{C}$
Coulomb Constant	k	$9.0 \times 10^{9}\ \text{N m}^2.\ \text{C}^{-2}$
Permittivity of free space	ε_0	$8.85 \times 10^{-12}\ \text{C}^2\text{N}^{-1}.\text{m}^{-2}$

LIST OF FORMULA

NEWTONIAN MECHANICS

$$\omega = \frac{\Delta\theta}{\Delta t} \qquad v = r\omega \qquad a = r\alpha$$

$$\omega = \omega_o + \alpha t \qquad \theta = \frac{1}{2}(\omega_0 + \omega)t \qquad \theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha\theta \qquad \theta = \omega t - \frac{1}{2}\alpha t^2$$

$$W = Fs\cos\theta \qquad KE = \frac{1}{2}mv^2 \qquad PE_G = mgy$$

$$P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v} \qquad p = mv \qquad \sum F = \frac{\Delta p}{\Delta t}$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad m_1u_1 + m_2u_2 = (m_1 + m_2)\,v$$

ELECTRICITY

$q = Ne$

$F = k\frac{q_1 q_2}{r^2}$

$E = \frac{F}{q_o}$

$E = k\frac{q}{r^2}$

$\Phi = EA\cos\theta$

$\Phi_c = \frac{q_{in}}{\varepsilon_o}$

$V = \frac{U}{q_o}$

$V = \frac{kq}{r}$

$U = k\frac{q_1 q_2}{r_{12}}$

$C = \frac{\varepsilon_0 A}{d}$

$Q = CV$

$C = \kappa C_0$

$C_{eq} = C_1 + C_2 + \ldots.$

$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots.$

$V = E\,d$

$U = ½\,QV$

$U = ½\,CV^2$

$U = \frac{Q^2}{2C}$

$u_E = ½\,\varepsilon_o E^2$

$I_{av} = \frac{\Delta Q}{\Delta t}$

$V = IR$

$R = \rho\frac{L}{A}$

$R_{eq} = R_1 + R_2 + \ldots$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

$P = IV$

$P = I^2 R$

$P = \frac{V^2}{R}$

$V = E - Ir$

SECTION A

Instructions: Answer **ALL** questions in this section. Write your answers in the Answer Booklet.

Question 1 [15 marks]

(a) The platter of the hard disk of a computer rotates at 5500 rpm (revolutions per minute).

(i) What is the angular velocity of the disk? **[2 marks]**

(ii) If the reading head of the drive is located 2.5 cm from the rotation axis, what is the speed of the disk below it? **[1 mark]**

(iii) What is the radial acceleration of this point? **[1 mark]**

(iv) If the disk took 3.0 s to spin up to 5500 rpm from rest, what was the average angular acceleration? **[1 mark]**

(b) Define work. Is it possible to do work on an object that remains at rest? **[2 marks]**

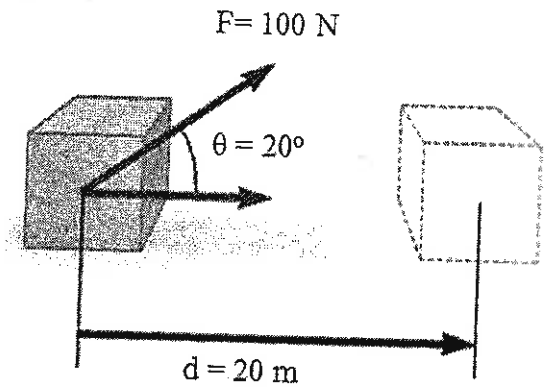

Figure 1

(c) A 20.0 kg crate is pulled 20.0 m along a horizontal floor by a constant force, F_p = 100 N, which acts at a 20° angle as shown in **Figure 1**. The floor is rough and exerts a friction force, fr = 50 N. Determine the work done by each force acting on the crate. **[4 marks]**

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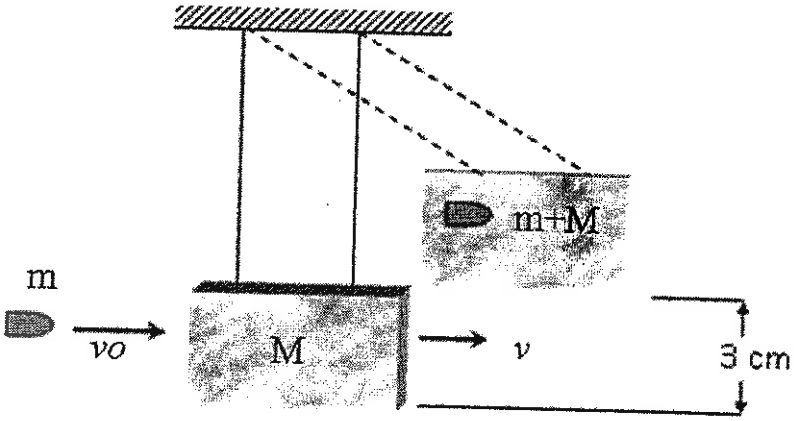

Figure 2

(d) **Figure 2** shows a 5 gram bullet traveling 200 m/s penetrates into a large block of wood of mass 2.0 kg suspended from some light wires. The bullet is stopped by the block, and the entire system swings through the vertical distance of 3 cm. Calculate

(i) the speed of the block and embedded bullet just after the impact. **[3 marks]**

(ii) State whether this collision process is elastic or inelastic. **[1 mark]**

Question 2 [15 marks]

(a) Define current. **[1 mark]**

(b) 25×10^{20} electrons pass through a light bulb in 10 minutes, what is the current supply to the bulb? **[2 marks]**

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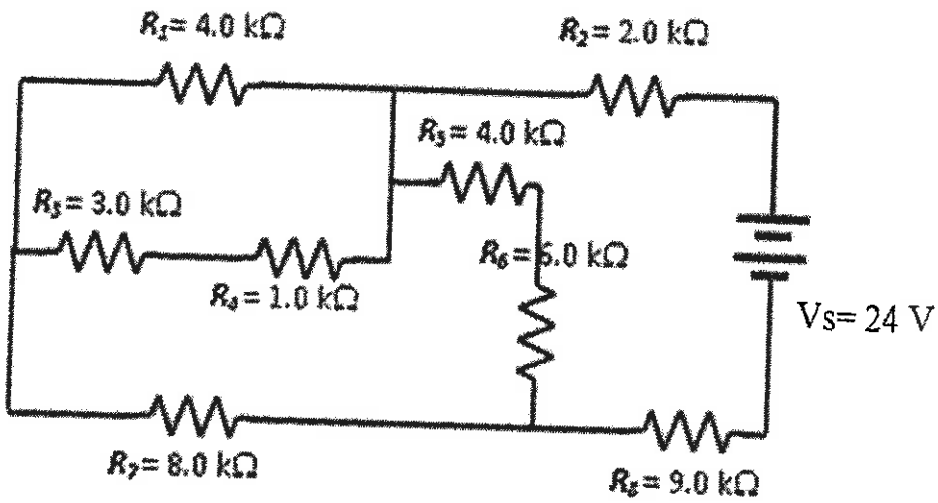

Figure 3

(c) **Figure 3** shows a circuit containing 8 resistors and a voltage source.

(i) Find the total resistance for this circuit. **[4 marks]**

(ii) Find the total current for this circuit. **[1 mark]**

(d) (i) What is doping? **[1 mark]**

(ii) What is the purpose of doping an intrinsic semiconductor material? **[1 marks]**

(iii) Sketch diagrams to show how a *pn* junction can be reverse-biased and forward biased. **[2 marks]**

(iv) What is depletion region? Explain the changes (if any) on the depletion region when a *pn* junction is in forward –biased and reverse-biased. **[3 marks]**

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Question 3 [15 marks]

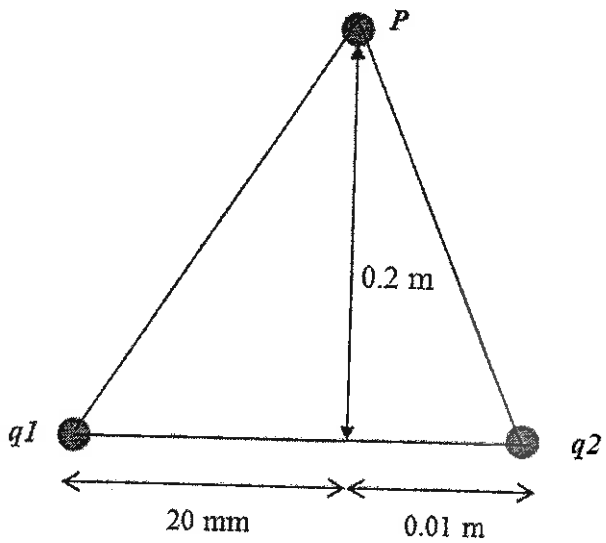

Figure 4

(a) A configuration of two charged particles $q1$ = 5.0 nC and $q2$ = 9.5 nC is place at two different points as illustrated in **Figure 4.**

(i) What is the total electric potential at point P ? **[3 marks]**

(ii) How much work must be done to carry a charge, $q3$ = - 5.0 nC from infinity to point P? **[2 marks]**

(iii) What is the total electric potential energy stored in the system when $q3$ = - 5.0 nC is located at point P. **[3 marks]**

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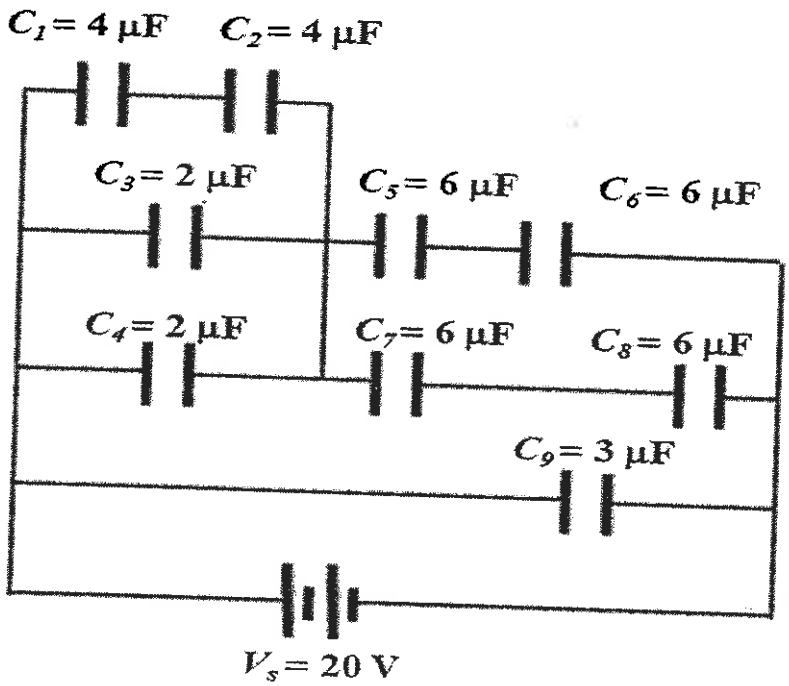

Figure 5

(b) In **Figure 5**, nine capacitors are connected to a 20 V source. Determine,

(i) the total capacitance for the circuit. **[5 marks]**

(ii) the total charge stored in the circuit. **[1 mark]**

(iii) the total energy stored in C_9. **[1 mark**

SECTION B

Instructions: This section consists of **TWO (2)** questions. Choose **ONE** question only in this section.

Question 4 [15 marks]

(a) Two very small spheres are initially neutral and separated by a distance of 0.50 m. Suppose that 3.0×10^{13} electrons are removed from one sphere and placed on the other.

(i) What is the magnitude of the electrostatic force that acts on each sphere? **[4 marks]**

(ii) Is the force attractive or repulsive? Why? **[2 marks]**

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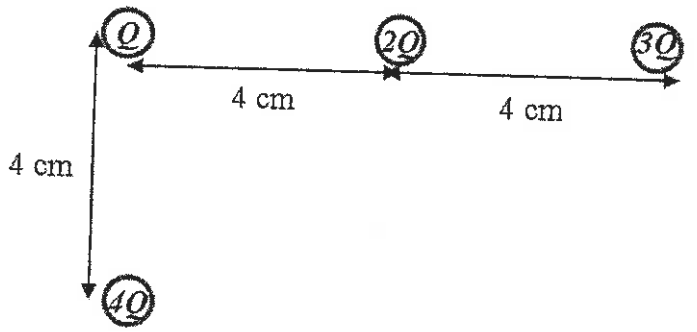

Figure 6

(b) Four point charges are Q, $2Q$, $3Q$, and $4Q$, where Q = 5.0 μC (**Figure 6**). Calculate the net force acting on the charge Q due to the other three charges. **[5 marks]**

(c) (i) Define Gauss's law. **[1 mark]**

(ii) Calculate the electric flux, Φ, if the Gaussian Surface covers the entire charges in **Figure 6**. **[2 marks]**

(iii) Is the net electric flux directed inward or outward from the surface? **[1 mark]**

Question 5 [15 marks]

(a) State the law of charges. **[1 mark]**

(b) A person scuffing her feet on a wool rug on a dry day accumulates a net charge of - 40μC . How much excess electrons does this person get ? **[2 marks]**

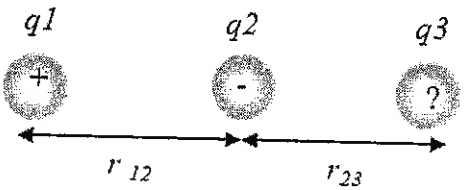

Figure 7

(c) **Figure 7** shows three charges labeled as ***q1*** = 5.0 μC, ***q2*** = -10.0 μC and unknown charge ***q3***, lies on a horizontal axis.

(i) If the system is found to be in equilibrium, what is the type of charge in ***q3*** ? **[1 mark]**

(ii) Base on your answer in (c)(i), calculate the charge ***q3*** when the system is in equilibrium if r_{23} is tripled compared to r_{12}. **[3 marks]**

Continued.....

(d) Two point charges of opposite sign and same magnitude 2.0×10^{-7} C are separated by a distance of 0.15 m. Find the magnitude and direction of the electric field strength , E at the mid-point between the charges. **[5 marks]**

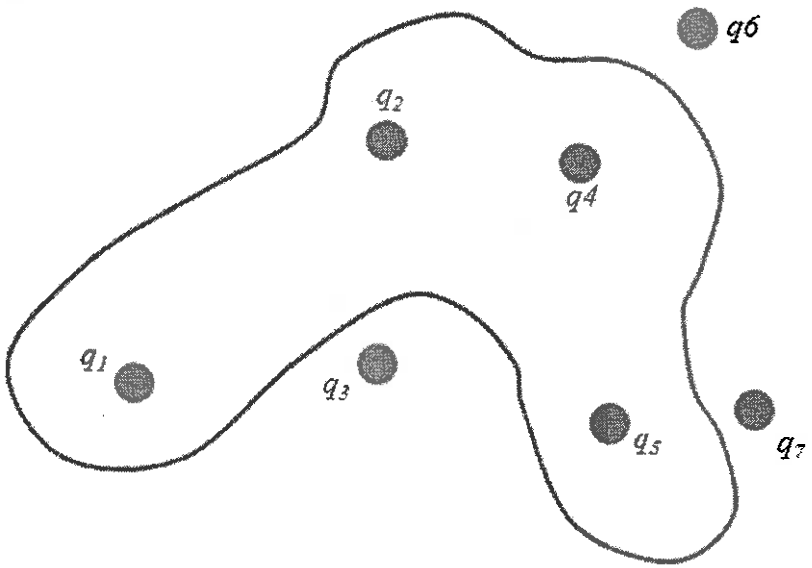

Figure 8

(e) (i) Determine the net electric flux through the surface (**Figure 8**) according to Gauss's Law. Given $q1$ = -5.0 nC, $q2$ = +3.5 nC, $q3 = q4$ = 5.0 nC, $q5$ = -5.0 nC and $q6 = q7$ = -10.0 nC. **[2 marks]**

(ii) Is the net electric flux directed inward or outward from the surface? **[1 mark]**

End of Paper